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One-Litter Outdoor Farrowing System by using Artificial Insemination and Hoop Structures

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Abstract
The one–litter outdoor system of pork production may be improved with advanced technology. Artificial insemination and low cost gestation housing allow replacement gilts to be produced at a lower cost. Electric fencers, all terrain vehicles, and improved management all provide the hog producer an opportunity to raise more hogs at lower cost and with reduced labor. This article provides a budget for a one-litter system in which three groups of 100 sows each are farrowed annually. Seven hundred-fifty pigs are raised to 50 lb from each farrowing. Then, 300 pigs per group are saved from the maternal cross as well as six terminal boars and are finished in hoop structures. Of 900 pigs finished, 390 (130 per group) are kept for replacement gilts (using the hoops for gestation). The remaining are sold as market hogs. Of 130 gilts, 30 are assumed to be non breeders and are sold as open gilts. The remaining 100 gilts are farrowed the following year and sold immediately after weaning. This system farrows 300 litters and markets 2,250 feeder pigs, 500 market hogs, 90 cull gilts, and 300 cull sows per year. Based on current prices (1997) and 7.5 pigs weaned per litter, the cost of production was $41 per 50 lb–pig for all costs; or $32 per 50 lb–pig excluding labor. The system budget is competitive with more capital-intensive confinement systems.

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Summary and Implications

The one–litter outdoor system of pork production may be improved with advanced technology. Artificial insemination and low cost gestation housing allow replacement gilts to be produced at a lower cost. Electric fencers, all terrain vehicles, and improved management all provide the hog producer an opportunity to raise more hogs at lower cost and with reduced labor.

This article provides a budget for a one-litter system in which three groups of 100 sows each are farrowed annually. Seven hundred-fifty pigs are raised to 50 lb from each farrowing. Then, 300 pigs per group are saved from the maternal cross as well as six terminal boars and are finished in hoop structures. Of 900 pigs finished, 390 (130 per group) are kept for replacement gilts (using the hoops for gestation). The remaining are sold as market hogs. Of 130 gilts, 30 are assumed to be non breeders and are sold as open gilts. The remaining 100 gilts are farrowed the following year and sold immediately after weaning. This system farrows 300 litters and markets 2,250 feeder pigs, 500 market hogs, 90 cull gilts, and 300 cull sows per year. Based on current prices (1997) and 7.5 pigs weaned per litter, the cost of production was $41 per 50 lb–pig for all costs; or $32 per 50 lb–pig excluding labor. The system budget is competitive with more capital-intensive confinement systems.

Methods

Gestation, breeding, and sow replacement. Female replacement is a key element in the one- litter system because females are replaced every year. Replacement gilts are raised on-farm to reduce costs and health risks. By using artificial insemination to breed all or most of the gilts a supply of replacement gilts and boars can be produced on-site. The first gilts to cycle are bred artificial insemination (A.I.) to maternal sires. Hoop buildings are used to finish all of the gilts produced from these matings, as well as a majority of the terminal cross-market hogs. Market barrows and cull gilts are removed, as they become ready for slaughter. The replacement gilts are left in the hoop, which becomes the gestation housing. The boars are housed in individual huts between the hoop structures to provide ready access to the gilts for ease of heat detection. Gestation feeding occurs on an 18 ft by 180 ft feeding floor in front of the hoop structures.

Facility fixed costs are $36.44 per litter as shown in Table 1. For the finishing/replacement budget, a charge of $45 per 50–lb feeder pig is used. Feeder pigs are taken to market weight. The costs used are from a finishing budget for hoops, except for the feed prices. Feed prices were set by the authors to be slightly above market value. Table 2 shows variable costs from feeder-to-finish.

Table 1. Gestation and breeding facilities fixed costs.

Item	Quantity	Life exp.	Price	Total cost	Total cost per yr.
Hoop buildings	3	7	$17,000		$7,286
Feeding floor	1	7	$3,250	$3,250	$464
Feeding fence	17	7	$100	$1,700	$243
Boar shelters	6	7	$150	$900	$129
Breeding dividers	18	7	$75	$1,350	$193
Sub total				$58,200	$8,314
Int. (9%)					
Fixed costs/year					$10,933
Total fixed costs/litter					$36.44

When the pigs reach 250 lb, all are sold for slaughter except 130 gilts per farrowing group and the six terminal-sired boars. Table 3 is a budget of the sale of these animals as well as the sale of the nonbred gilts, weaned sows, and boars. A death loss of 4.33% for the market hogs was assumed. A death loss of 4% for the boars and a loss of 2% of the gilts was included. A marketing fee ($2) was charged for each pig.

Table 2. Feeder-to-finish variable costs.

Item	Units	Price per unit	Total
Feeder pigs	900	$45.00	$40,500
Corn	7,970	$2.75	$21,918
Supplement	111,600	$0.2	$22,320
Bedding	180,000	$.0075	$1,350
Labor	300	$7.00	$2,100
Vet/medical	900	$1.50	$1,350
Fuel & repairs	900	$0.50	$450
Interest	900	$2.20	$1,980
Total			$91,968

Table 3. Market hog and cull revenue budget.

Item	Units	Weight	Price	Total
Culled gilts	130	250	$0.48	$15,600
Non bred gilts	90	375	$0.35	$11,813
Barrows	335	250	$0.48	$40,200
Sows	292	400	$0.35	$40,914
Boars	6	500	$0.30	$864
Marketing costs ($/hd.)	853		-$2.00	-$1,706
Total				$107,684
Total per litter				$359

The replacement gilts are developed in the hoop structures for an additional 75 days beyond market weight or until approximately 8 months of age. Table 4 provides a budget for all other gilt replacement expenses until breeding. Prefarrowing vaccines are included in the main budget.

Table 4. Gilt development.

Item	Units	Price/unit	Total
Corn	2,122	$2.75	$5,836
Supp.	29,700	$0.20	$5,940
Bedding	40,000	$0.0075	$300
Fuel/repairs	396	$0.25	$99
Medical/vet.	396	$1.00	$396
Labor	160	$7.00	$1,120
Interest/misc.	396	$1.00	$396
Total			$14,087

396 head includes 6 boars.

Breeding using A.I. occurs on the feeding floor adjacent to the boar pens (Figure 1). Gates made of plywood are used for portable, inexpensive stalls. The first 57 gilts to come in heat are bred to maternal sires. The remaining gilts are bred using terminal sires to achieve 100% heterosis. The semen costs were based on 1997 semen prices. Table 5 summarizes the A.I. costs.

Each gilt (130 per group) is inseminated using two doses of semen. The breeding occurs when the gilts are 8 months old (Nov., Jan., and April). In this program, sows farrow at 1 year of age after being born (March, June, and Sept.).

Table 5. A.I. budget.

Breeding costs	Units	Price	Total
Maternal semen	342	$9.00	$3078
Terminal semen	456	$8.00	$3648
Labor	400	$7.00	$2800
Total			$9526

Table 6 summarizes the breeding costs. The cost of support facilities, feed, and bedding during breeding are included in the main budget. The net variable cost is figured by subtracting the variable cost from the replacement animal resale revenue.

Table 6. Replacement and breeding cost summary.

Breeding costs	Per year	Per litter
Net variable costs	$5,571	$18.57
Fixed costs	$10,933	$36.44
Total net breeding costs	$16,504	$55.01

	Total units	Price/unit	Total	Per litter
Labor	860.00	$7.00	$6020	$20
Feed	706452	$0.08	$56013	$187

Farrowing and support equipment. Individual modified A-frame huts are used for farrowing on pasture. Sheds (12 ft by 20 ft) for group lactation allow some of the modified A-frames to be used twice during each farrowing period. These portable sheds allow for easier sorting and bedding at weaning after group lactation.

Summer watering is accomplished by using portable plastic pipe and tanks. The tanks help prevent mud holes from forming and provide a reserve of water in case of temporary water loss. Also, on extremely hot days the excessive demand could make water pressure difficult to maintain. Lactating sows are fed by self-feeders. These feeders also work as feeders for the pigs after weaning.

Table 7. Farrowing & nursery facilities.

Item	Qty.	Life exp.	Price	Total cost	Per year
Fencer	1	10	$200	$200	$20
Battery	1	5	$65	$65	$13
Modified A frame huts	70	7	$130	$9,100	$1,300
Portable sheds	10	10	$1,000	$10,000	$1,000
Water tanks	10	7	$240	$2,400	$343
Pipe	1300	7	$.30	$390	$56
Floats/tank connectors	10	5	$20	$200	$40
Elec. fence	40	7	$100	$4,000	$571
Wood posts	18	10	$8	$144	$14
Self-feeders	10	10	$470	$4,700	$470
Sub total				$31,199	$3,827
				Per litter	$12.76
Interest		Total	$1,404	Per litter	$4.68
Total/litter					$17.44

For the farrowing/nursery facilities (Table 7) interest is based at 9% for the average cost of the facilities. Facilitiy costs were divided by two to determine the average cost. The average facility costs were then divided by three litters per year and then again by 100 sows per farrowing period to determine cost per litter. Except for the hog mover, support equipment was assumed to be shared with other farm enterprises, such as cattle and crops (Table 8).

Table 8. Support equipment budget.

	Quan-tity	Life exp.	Price	Total cost	Per year
Hog mover	1	10	$4,500	$4,500	$450
Loader	1	10	$2,000	$2,000	$200
Feed Handling Equipment	1	10	$1,000	$1,000	$100
Manure spreader	1	10	$3,000	$3,000	$300
Tractor	1	10	$10,000	$10,000	$1,000
ATV	1	10	$2,500	$2,500	$250
Subtotal				$23,000	$2,300
				Per litter	$7.67
Interest		Total	$1,035	Per litter	$3.45
Total per litter					$11.12

The sows are moved outdoors and farrow in 10-acre lots fenced with electric fence. The lots are planted to a sod-based crop. When the sows farrow, the land is replanted for the March farrowing or fully harvested for the September farrowing. This allows producers to utilize land with little or no loss of crop production. In the budget (Table 9), land for June farrowing was counted fully as land used even though the producer would be able to take a partial harvest of hay or straw. Land for the other farrowings was not charged or an expense because it is fully used in crop production. Land cost was $110 per acre, which is the cash rent of low value cropland.

The sows are farrowed in modified A-frame huts and kept there until the piglets are 10–14 days of age. Then the modified A-frame huts are replaced with 12 ft by 20 ft portable sheds for group lactation. Weaning occurs by simply removing the sows.

The budget assumes that the number of live pigs born was 9.5/litter with two pigs/litter death loss from farrow to 50 lb. Feed amounts for gestating sows and feeder pigs are from ISU Life Cycle Swine Nutrition.

After 4–5 weeks of lactation, the sows are removed and the pigs are raised to approximately 50 lb in the paddock where they were farrowed. Pigs can be directly moved to the hoop structure if the land is needed for planting crops, or if there is adverse weather. At approximately 50 lb, all the feeder pigs will be sold except the 300 maternal line gilts that are finished out.

Results and Discussion

Return on investment is a key measure in deciding whether or not to undertake an enterprise. For this system the return on investment is 21% (Table 10). The average investment for this system was figured by adding the total facility cost plus breeding stock investment (there was a $300 charge minus the income received for boars, nonbred gilts, and sow sales) then dividing by two. Net return is figured by adding return of labor and management to the interest and then subtracting labor as an opportunity cost. Return on investment is determined by dividing net return by the average investment.

Because the budget is very sensitive to feed cost, it is important to evaluate the break-even prices of feeder pigs in this system at different feed cost levels. Table 11 shows the effect of feed costs on break-even price to cover variable costs, break-even price to cover total costs, and break-even price if labor is excluded. The price of the feeder pigs used for replacement animals was set at $45 per head. Feeder pig price changes would affect break-even prices because the feeder pigs are bought from the operation at market value.

Table 9. Budget for an outdoor one-litter farrow to feeder system by using hoopp structures for gi development and gestation (per litter basis).

Item	Price	Units	Per litter revenue	Per litter costs
Revenue				
Feeder pigs	45	7.5	$337.50	
Variable costs				
Corn	2.75	19		$52.25
Supplement	0.2	260		$52.00
Total feed costs				$104.25
Vet/health	15	1		$15.00
Marketing	13.8	1		$13.80
Bedding	15	1		$15.00
Net variable breeding costs				$26.32
Repairs	5	1		$5.00
Power/fuel	10	1		$10.00
Total				$189.37
Interest on variable				$4.26
Total variable				$193.63
Income over variable				$143.87
Fixed costs				
Gestation/ breeding facilities				$36.44
Nursery/ farrowing facilities				$17.44
Support facilities				$11.12
Land	110	0.033		$3.67
Total fixed costs				$68.67
Total costs without labor				$262.30
Labor	7	6		$42.00
Total all costs				$304.30
Return to management				$33.20
Return to labor & management				$95.27
Break-even var. costs per pig				$25.82
Break-even total costs per pig				$40.57
Break-even costs excluding labor per pig				$32.30

Table 10. Return on investment.	
Facilities	$112,399
Breeding stock	$65,210
Total investment	$177,609
Ave. investment	$88,804
Interest	$8,712
Return to management	$9,961
Labor	$18,620
Return to management & labor	$28,581
Net return	$18,673
Return on investment (%)	21

Table 11. Feeder pig break-even prices per head at different feed costs

Corn price per bushel	Supplement price per pound	Break-even price per head, variable cost	Break-even price per head, total cost	Break-even price per head, excluding labor
$1.75	$0.12	$11	$25	$17
$2.00	$0.14	$14	$29	$20
$2.25	$0.16	$18	$33	$24
$2.50	$0.18	$22	$37	$29
$2.75	$0.20	$26	$41	$31
$3.00	$0.22	$30	$44	$36
$3.25	$0.24	$33	$48	$40
$3.50	$0.26	$37	$52	$44
$3.75	$0.28	$41	$56	$47
$4.00	$0.30	$45	$60	$51
$4.25	$0.32	$49	$63	$55
$4.50	$0.34	$52	$67	$59
$4.75	$0.36	$56	$71	$63
$5.00	$0.38	$60	$75	$66

Table 12. Break-even feeder pig prices at different sow prices.

Sow price $/cwt	Break-even price per head, variable cost	Break-even price per head, total cost	Break-even price per head, excluding labor
$25	$33	$47	$39
$30	$29	$44	$36
$35	$26	$41	$32
$40	$22	$37	$29
$45	$19	$34	$25
$50	$16	$30	$22

Another area of sensitivity is the income received for the cull sows. This is because the sows are sold and restocked after each litter. Table 12 demonstrates the sensitivity of break-even prices at varying sow cull prices.

Tables 13 and 14 are sensitivity Tables that evaluate returns at different feed and feeder pig prices. Table 13 shows the return to management. Table 14 shows the return to both labor and management. Both represent annual returns.

Table 13. Return to management at varying feeder pig and feed prices.

		Feeder pig prices (per head)							
Corn price per bu	Supple-ment price per lb	$25	$30	$35	$40	$45	$50	$55	$60
$1.75	$0.12	$17,452	$24,101	$30,750	$37,399	$44,047	$50,696	$57,345	$63,994
$2.00	$0.14	$8,931	$15,580	$22,228	$28,877	$35,526	$42,175	$48,823	$55,472
$2.25	$0.16	$409	$7,058	$13,707	$20,356	$27,004	$33,653	$40,302	$46,951
$2.50	$0.18	-$8,112	-$1,463	$5,185	$11,834	$18,483	$25,132	$31,780	$38,429
$2.75	$0.20	-$16,634	-$9,985	-$3,336	$3,313	$9,961	$16,610	$23,259	$29,908
$3.00	$0.22	-$25,155	-$18,507	-$11,858	-$5,209	$1,440	$8,089	$14,737	$21,386
$3.25	$0.24	-$33,677	-$27,028	-$20,379	-$13,731	-$7,082	-$433	$6,216	$12,864
$3.50	$0.26	-$42,198	-$35,550	-$28,901	-$22,252	-$15,603	-$8,955	-$2,306	$4,343
$3.75	$0.28	-$50,720	-$44,071	-$37,422	-$30,774	-$24,125	-$17,476	-$10,827	-$4,179
$4.00	$0.30	-$59,241	-$52,593	-$45,944	-$39,295	-$32,646	-$25,998	-$19,349	-$12,700
$4.25	$0.32	-$67,763	-$61,114	-$54,465	-$47,817	-$41,168	-$34,519	-$27,870	-$21,222
$4.50	$0.34	-$76,284	-$69,636	-$62,987	-$56,338	-$49,689	-$43,041	-$36,392	-$29,743
$4.75	$0.36	-$84,806	-$78,157	-$71,508	-$64,860	-$58,211	-$51,562	-$44,913	-$38,265
$5.00	$0.38	-$93,327	-$86,679	-$80,030	-$73,381	-$66,732	-$60,084	-$53,435	-$46,786

Table 14. Return to management and labor at varying feeder pig and feed prices.

		Feeder pig prices (per head)							
Corn price per bu	Supplement price per lb	$25	$30	$35	$40	$45	$50	$55	$60
$1.75	$0.12	$36,072	42,721	49,370	56,019	62,667	69,316	75,965	82,614
$2.00	$0.14	$27,551	34,200	40,848	47,497	54,146	60,795	67,443	74,092
$2.25	$0.16	$19,029	25,678	32,327	38,976	45,624	52,273	58,922	65,571
$2.50	$0.18	$10,508	17,157	23,805	30,454	37,103	43,752	50,400	57,049
$2.75	$0.20	$1,986	8,635	15,284	21,933	28,581	35,230	41,879	48,528
$3.00	$0.22	$-6,535	114	6,762	13,411	20,060	26,709	33,357	40,006
$3.25	$0.24	$-15,057	-8,408	-1,759	4,889	11,538	18,187	24,836	31,484
$3.50	$0.26	$-23,578	-16,930	-10,281	-3,632	3,017	9,665	16,314	22,963
$3.75	$0.28	$-32,100	-25,451	-18,802	-12,154	-5,505	1,144	7,793	14,441
$4.00	$0.30	-40,621	-33,973	-27,324	-20,675	-14,026	-7,378	-729	5,920
$4.25	$0.32	-49,143	-42,494	-35,845	-29,197	-22,548	-15,899	-9,250	-2,602
$4.50	$0.34	-57,664	-51,016	-44,367	-37,718	-31,069	-24,421	-17,772	-11,123
$4.75	$0.36	-66,186	-59,537	-52,888	-46,240	-39,591	-32,942	-26,293	-19,645
$5.00	$0.38	-74,707	-68,059	-61,410	-54,761	-48,112	-41,464	-34,815	-28,166

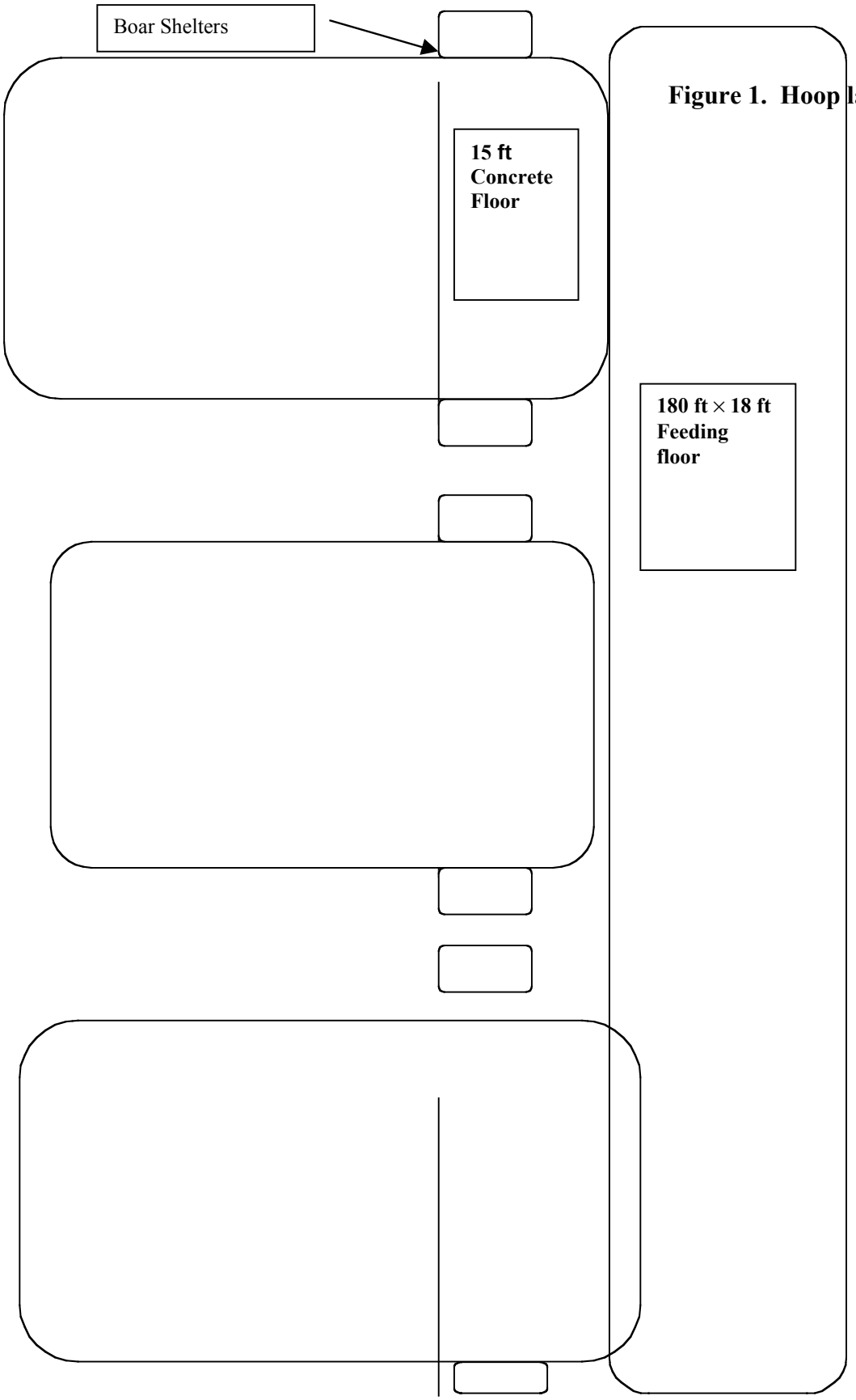

Figure 1. Hoop layout.

Acknowledgments

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